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Performance analysis of a synchronous, circuit-switched interconnection cached network

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ABSTRACT

In many parallel applications, each computation entity (process, thread etc.) switches the bulk of its communication between a small group of other entities. We call this phenomenon switching locality. The Interconnection Cached Network (ICN) is a reconfigurable network especially suited for exploiting switching locality. It consists of many small, fast crossbars interconnected by a large, slow switching crossbar. The large crossbar is used for topology reconfiguration and the smaller crossbars for circuit switching. For a large class of communication patterns displaying switching locality (this includes meshes, tori, trees, rings, pyramids, etc.), it is possible to choose appropriate ICN configurations and assignments of processes to processors such that all communication paths pass through two or less switching components. Much of the previous work on performance analysis of networks has assumed random, uniformly distributed communication and is inapplicable to many real-life parallel applications that lack this uniformity. We develop a methodology to analyze the performance of synchronous, circuit switched networks under different communication traffic patterns. We employ this methodology to study the performance of the ICN in comparison to more popular reconfigurable networks: the delta and the crossbar. We choose two different communication patterns—a 2-D torus representing a high degree of switching locality and a fully connected graph representing complete absence of such locality. We show that in the presence of locality, the ICN comes very close to matching the crossbar's performance. This, together with the shorter network cycle period of the ICN, makes it more desirable. In the absence of switching locality, the reconfigurability of the ICN allows for a graceful degradation in performance.

REFERENCES

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